we withdraw about 3 liters from a large man during his second aspiration, when 1½ liters had been withdrawn only a few days before. Such large amounts can easily be dangerous to life, because of the now known although not generally appreciated elasticity of the mediastinum which produces interference with the other side of the thorax.

We have practised preliminary tapping in all forms of empyemata at Mercy Hospital for many years, when cases were not too urgent, and believe strongly in it.

The problem of washing the pleural cavity after the resection and insertion of the tubes is worthy of great consideration, and we believe this may be the better plan, judging from the experience of other men, and shall consider it in the future should such cases come under our care. One case of a colleague not in this group did well under the Carrel-Dakin solution. This may shorten the time of cure.

Our own feeling was for costatectomy instead of thoracotomy, and this we had performed. Many other men are in favor of the latter and with a simpler procedure and earlier washing with the Carrel-Dakin solution this may suffice for cure in some cases. The fact that two of our patients required second resection to establish sufficient drainage, although well done at the primary operation, makes us in favor of the former at present.

There were 2 cases in this group of dense adhesions which presented a problem difficult of solution and are yet unsolved. The 7 cases due entirely to the Streptococcus hemolyticus treated as we have outlined, and with no deaths, seems to warrant this record. The disappointments were the long periods of convalescence and the dense adhesions which followed in 2 of the cases. The use of the Carrel-Dakin solution in the future may remove such disappointments.

INTERNAL HYDROCEPHALUS IN A SYPHILITIC, PROBABLY DUE TO INTRASPINAL TREATMENT.

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AND

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The common dangers of the intraspinal treatment of neurosyphilis have been discussed by various writers and are now generally known. Among the most important are septic meningitis, due to faulty technic; death from respiratory paralysis; paraplegia; loss of bladder and rectal sphincter control; sensory changes about the perineum and in the legs. So far as we have been able to determine, internal hydrocephalus has not been mentioned in this connection. We therefore wish to record a case presenting this interesting but distressing complication.

History. The patient is a young white man, an attorney by profession, aged thirty-two years. He has been married for five years, but there have been no pregnancies.

In 1907 he contracted a genital sore, which was painful, with a seropurulent discharge but no local adenopathy. The sore persisted for six months. One month after its appearance he developed a sore throat, followed in another month by rheumatic pains and by small sores in the mouth. Three months later a generalized macular rash, together with lesions at the anus, appeared. Treatment consisted of "powder" by mouth.

In 1912 he began to suffer with occasional mild headaches, worse in the late afternoon and night, and with shooting pains in the legs. The headaches persisted with increasing severity until 1915, when they became severe enough to cause him to consult a physician. The blood Wassermann at that time was positive. One intravenous injection, presumably arsphenamin, followed by a course of intramuscular mercury and potassium iodide, brought about a decided improvement.

During the next three years he developed loss of libido and potentia, girdle sensation, difficulty in mental concentration and a change in disposition manifested by heavy drinking. The headache did not recur until about July, 1918, and was then of only slight intensity; it followed his rejection by an Army Medical Examining Board because of a diagnosis of "cerebrospinal syphilis." He was told at this time that the Wassermann of the blood and spinal fluid were both positive, whereupon he placed himself under treatment, consisting of six intravenous injections of arsphenamin and one intraspinal injection of mercurialized serum. Following this the blood Wassermann was said to have become negative.

Several hours after the intraspinal treatment there was a severe reaction, consisting of excruciating headache and pains in the legs lasting for four days, during which time he remained in the hospital. When he went home on the fifth day he felt fairly well, but on the sixth day he was suddenly seized with a fresh, terrific headache and pains in the legs. For the next forty-eight hours he was said to have been delirious and to have had a high temperature. He had stiffness of the extremities and retraction of the head. With this late reaction he remained in bed ten days.

For the next six weeks he felt quite well, but gradually an entirely new sort of headache began. The old headache had been infrequent, mild and generalized. These new headaches were almost constant, occipital and of terrific intensity. To quote his own expression, he "nearly went crazy with the pain." On two occasions during this phase of his condition he attempted suicide.

Physical Status. In December, 1918, he consulted one of us. At that time the physical examination showed round, regular pupils of the Argyll-Robertson type, coarse tremor of the tongue, pain on pressure over the cervical spine, absent knee- and ankle-jerks and oral sepsis. Psychiatric examination showed none of the characteristic signs of general paralysis.

Serology. The blood Wassermann was negative; the cerebrospinal fluid examination showed fifty cells, a strongly positive globulin test, Wassermann positive with 0.1 c.c. and a paretic type gold curve.

Treatment. When first seen his headaches were thought to be due to cerebrospinal syphilis, and from December 23, 1918, until October, 1919, he was kept under continuous antisyphilitic treatment. During this time he received seven intraspinal injections of mercurialized serum according to a method described by us,[1] six spinal drainages followed by arsphenamin and eleven separate intravenous injections of arsphenamin products, a total of twenty-four intravenous arsphenamins. From the standpoint of serology the results obtained were gratifying. The blood Wassermann remained negative and on October 14, 1918, the cerebrospinal fluid showed six cells, a slightly positive globulin, Wassermann negative with 1.0 c.c. and a negative gold curve.

Progress. Clinically, however, it was noted that the patient improved but little. Reactions following the intraspinal treatments were exceptionally severe, consisting of unbearable headache and pains in the legs, rendering a continuation of intraspinal medication impossible.

From December, 1918, until July, 1919, the headache continued almost as severe as before. During the next three months, however, a very considerable improvement took place; but after an intraspinal treatment on November 3 the pain recurred and rapidly grew worse until, during December, headache was constant, sometimes requiring morphin for relief.

November 29, examination of the eye-grounds disclosed unilateral choked disk right, with some edema of the left disk, and a high degree of vascular sclerosis. Consultation with an ophthalmologist revealed in addition marked compound hypermetropic astigmatism. With the hope that the edema of the disk would subside spontaneously and that the refraction error might, at least partially, account for the headache the error was corrected with glasses, but without relief.

In reviewing the patient's course at this time we found as evidence of increased intracranial pressure the severe headache and the low-grade choked disks, but no nausea, vomiting, bradycardia or localizing symptoms. It was recalled that from May 2 until

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[1] Keidel, A., and Moore, J. E.: Treatment of Neurosyphilis by the Intraspinal Route, Johns Hopkins Hosp. Bull., November, 1920, xxxiv, 404.

October 4 treatment had been intravenous only, no lumbar punctures having been done. October 4, 11, 25 and November 3 spinal drainage was carried out. On the first date (October 4) the pressure was markedly increased and the fluid spurted out in a steady stream to a distance of several inches. When 70 c.c. had been rapidly removed the procedure was terminated for fear of reducing the intracranial pressure too quickly. At the four succeeding drainages it was noted that the pressure seemed to grow progressively lower, so that at the time of the last treatment, on November 3, spinal fluid flowed only drop by drop, and ceased to flow at all after 40 c.c. had been obtained.

Laryngological consultation on September 20 had been completely negative for any sinus disease, either of the frontals, antra, sphenoids or ethmoids.

It being by this time obvious that we were dealing with some intracranial condition, careful review of the various symptoms just outlined prompted the suspicion of an internal hydrocephalus, perhaps due to an old meningitis, with adhesions in the floor of the fourth ventricle.

Stereoscopic Roentgenologic Examination of the Head on December 29 showed the following rather startling picture: "The parietal sutures on both sides, especially near the top of the head, are distinctly separated. The lambdoidal sutures are also very decidedly separated. The sella turcica is quite large, but this may be a normal variation. There are no shadows to indicate a localized tumor in any place. There is no evidence of a periostitis to indicate lues. The condition suggested an intracranial pressure affair without being able to pick out the particular lesion. The paranasal sinuses show an absence of both frontals. The maxillary sinuses are small but clear."

Surgical Consultation. This lent added weight to our tentative diagnosis. December 31, 1919, Dr. George Heuer saw the patient in consultation and confirmed the presence of bilateral choked disk, more marked on the right. There was also a questionable bitemporal hemianopsia. Right subtemporal decompression was decided upon and was performed January 24, 1920. At operation very troublesome bleeding was encountered from the posterior branch of the middle meningeal artery as well as from the other dural vessels, all of which were much larger than normal. The dura was under slightly increased tension, and on pricking considerable fluid escaped. The brain was not bulging and no evidence of tumor was found. Two attempts at ventricular puncture failed.

During the patient's convalescence from this operation eight abscessed teeth were extracted and his oral hygiene considerably improved. Two months later the choked disks had subsided and the headache was almost completely relieved. He felt so well that he returned home and resumed his professional work. The improvement was only temporary, however, and in May, 1920, the same headaches recurred, usually after mental strain and in the early afternoon, always associated with tense bulging of the decompression area.

In July he returned to Baltimore, once more incapacitated by the severity of the headache. Serologic examination disclosed a negative blood Wassermann; in the cerebrospinal fluid there were eight cells, a weakly positive globulin reaction and a luetic zone gold curve. The spinal fluid Wassermann was negative with 0.2, 0.4 and 0.6 c.c., suggestive positive with 0.8 c.c. and positive with 1.0 c.c. In the absence of Dr. Heuer he was seen by Dr. Walter Dandy, who concurred in our diagnosis of internal hydrocephalus. According to the routine of study used for these cases by Dr. Dandy, intraventricular and intraspinal phthalein and roentgenograms after intraventricular and intraspinal air injections were proposed.

The patient refused all of these procedures except the intraspinal phthalein, which was carried out on July 16. Excretion of dye in the urine was as follows:

First two hours	Trace.
First fourteen hours	20 per cent.
Second twelve hours	5 "
Third twelve hours	2 "
Fourth twelve hours	1 "
Total (fifty hours)	28 "

Intramuscular phthalein on July 19: 43 per cent. excreted in two hours.

A recent letter informs us that his progress has been much the same. He continues to be partially incapacitated by headaches, which are worse whenever he exerts himself mentally or physically.

Discussion. In a series of papers Dandy and Blackfan[2, 3] and Dandy[4, 5] have thoroughly presented the question of hydrocephalus. Briefly summed up their clinical conclusions are as follows: Internal hydrocephalus can be divided into two anatomically different types, depending on the patency or occlusion of communication between the ventricles and the subarachnoid space. If communication is completely blocked off the hydrocephalus is obstructive. Absorption of cerebrospinal fluid cannot take place from the ventricles though from the subarachnoid space, which the fluid cannot reach, it may be normal. Communicating hydrocephalus results if the obstruction between the ventricular and subarachnoid system is incomplete. Clinically it was shown to occur because of the forma-

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[2] Internal Hydrocephalus, An Experimental, Clinical and Pathologic Study, Am. Jour. Dis. Children, December, 1914, viii, 406.

[3] Ibid., December, 1917, xiv, 424.

[4] Extirpation of the Choroid Plexus of the Lateral Ventricles in Communicating Hydrocephalus, Ann. Surg., December, 1918, p. 569.

[5] Experimental Hydrocephalus, Ann. Surg., August, 1919, p. 129.

tion of a barrier of dense adhesions (following meningitis) at the base of the brain, which, while sometimes permitting the passage of fluid from the ventricles to the spinal subarachnoid space, mechanically obstructed its flow to the cerebral subarachnoid space, where most of its absorption should take place. The communicating type of hydrocephalus has been produced in dogs by a perimesencephalic band of gauze, saturated in an irritant which induces adhesions.

The intraventricular introduction of phenolsulphonephthalein will conclusively demonstrate the classification of hydrocephalus. If phthalein is recoverable by spinal puncture within ten minutes thereafter the condition is communicating. Furthermore, absorption and excretion of phthalein injected intraspinally is usually normal, or nearly so, in the obstructive type of hydrocephalus, and is markedly reduced in the communicating type.

Dandy[6] [7] has also introduced the method of roentgenography of the air injected spinal and ventricular systems. This might be expected to show clearly any dilatation of the ventricles, which might be found in either type, as well as the failure of the air to reach the cerebral sulci or the ventricular system if blocked by a band of adhesions at the base as in communicating hydrocephalus.

In this case the diagnosis of internal hydrocephalus is, to our minds, fairly well established because of (1) the character of the headaches; (2) the presence of choked disk; (3) progressive decrease in the pressure and amount of cerebrospinal fluid during the successive punctures of October and November, 1919 (though a fair amount of fluid, somewhat less than normal, could always be recovered); (4) the temporary improvement after decompression; (5) the behavior of the excretion of phthalein injected intraspinally; (6) the striking roentgenoscopic picture.

It is, of course, essential to rule out cerebral or cerebellar neoplasm or cyst. The existence of such a lesion seems improbable because of the history of sudden onset, the lack of progress in the disease and the absence of localizing signs. It is probable that here the obstruction is only partial and that a certain amount of ventricular fluid is allowed to flow into the spinal system. It is unfortunate that roentgenoscopic studies of the air filled ventricles and spinal canal were not permitted. Such studies would have made the diagnosis more definite.

Unfortunately, also, the ventricular injection of phthalein was not permitted. This would have allowed a demonstration of the patency of the foramina between the ventricular and the subarachnoid systems. The intraspinal injection of phthalein did, however, afford the information that only a small part of the subarachnoid space was participating in the absorption of cerebrospinal fluid. Normally, after intraspinal phthalein 35 to 60 per cent. is excreted in two hours. In this patient there was but a trace in two hours and only 28 per cent. was excreted in forty-eight hours.

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[6] Ventriculography following the Injection of Air into the Cerebral Ventricles, Ann. Surg., July, 1918, p. 5.

[7] Roentgenography of the Brain after the Injection of Air into the Spinal Canal, Ann. Surg., October, 1919, p. 397.

Having concluded that in all probability the patient's headaches are due to internal hydrocephalus of the communicating type, questions arise as to the etiologic factors which produced this condition. Syphilis has, of course, been suggested by various authors, and is particularly noteworthy as a cause of infantile hydrocephalus. A syphilitic process which will almost completely occlude the foramina of exit of the cerebrospinal fluid from the ventricular system, or which will so affect the meninges as to produce a dense band of adhesions around the base of the brain, must in the adult be relatively uncommon, as few such cases of hydrocephalus in adults are observed. The possibility of such a condition due to syphilis is, however, admittedly academic. On the other hand the time relation of the first intraspinal injection to the onset of the characteristic headache stands out very strikingly. It must be admitted that for some time we failed to be impressed by this possible relation of cause and effect; but later consideration has urged upon us the conclusion that the first intraspinal injection given the patient set up a severe meningitis, which, since he survived it, was probably aseptic. This in healing produced a mass of adhesions about the subarachnoid space, causing a partial occlusion of one or more of the three foramina of exit from the fourth ventricle. Such a phenomenon must, however, be extremely rare, since we have been unable to find similar cases in the literature and since our own fairly large experience affords no like example.

The hydrocephalus in this case is of the communicating type, since there are periods of freedom from both headache and the bulging of the decompression area and since a fair amount of spinal fluid was usually obtainable at the time of puncture. The phthalein absorption is characteristic in that it was markedly reduced.

So far as treatment is concerned there would seem to be little to be done. The operation of choroid plexectomy is hazardous; according to Dandy it is impossible to break up adhesions at the base because of their inaccessibility. One can hope for a spontaneous cure. To quote Dandy and Blackfan:[8] "It is not difficult to imagine recovery following the gradual disappearance of adhesions. It is also possible to imagine a sudden rupture of the thin wall of a large fourth ventricle cyst, producing a new foramen of exit to the subarachnoid space."

Summary. 1. There is presented a case of communicating internal hydrocephalus in a neurosyphilitic.

2. The hydrocephalus appears to stand in the relation of effect and cause to an intraspinal treatment with mercurialized serum.

3. A possible though remote danger of intraspinal therapy is pointed out.

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[8] Loc. cit.